INEEL/EXT-02-01032

Annual Groundwater Monitoring Status Report for the Waste Area Group 5 for Fiscal Year 2002

October 2002

Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho, LLC

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Idaho National Engineering and Environmental Laboratory
Environmental Restoration Program
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE Idaho Operations Office
Contract DE-AC07-99ID13727

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ABSTRACT

This report presents the analytical and water level data collected in support of groundwater monitoring requirements at Waste Area Group 5 during Fiscal Year (FY) 2002. Sample collection and analysis requirements are defined in the *Groundwater Monitoring Plan for the Waste Area Group 5, Remedial Action*, and in the *Final Record of Decision for Power Burst Facility and Auxiliary Reactor Area (DOE-ID 2000b)*. The record of decision requires that surveillance monitoring of the groundwater underlying the Auxiliary Reactor Area (ARA) and Power Burst Facility (PBF) be conducted annually at least until the first five-year review. At that time, the analytical data will be reviewed and a joint decision made with the Agencies as to what changes or revisions are required for the monitoring effort. This report summarizes the second year of post-record of decision monitoring data and historical data collected in partial fulfillment of the requirements delineated in the record of decision.

Analytical results are presented based on groundwater samples collected during the annual sampling effort conducted in November 2001 for Fiscal Year 2002. Tables presenting the analytical data are found in Appendix A. Only lead exceeded the EPA action level for groundwater of 15 µg/L in three wells (ARA-MON-A-3A @ 15.6 µg/L; ARA-MON-A-004 @ 17.0 µg/L; and PBF-MON-A-004 @ 17.1 µg.L). Although data are limited upon which to base any discernable trends, discussion of potentially developing trends in analytes is provided. In addition to the analytical data, groundwater level measurements were made, and historical results are presented in Section 4.3 of this document.

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ACRONYMS

ARA	Auxiliary Reactor Area
DOE-ID	U.S. Department of Energy Idaho Operations Office
EPA	U.S. Environmental Protection Agency
FY	fiscal year
INEEL	Idaho National Engineering and Environmental Laboratory
INEL	Idaho National Engineering Laboratory
MCL	maximum contaminant level
PBF	Power Burst Facility
RI/FS	Comprehensive Remedial Investigation Feasibility Study
ROD	Record of Decision
RPD	relative percent difference
SMO	Sample Management Office
SPERT	Special Power Excursion Reactor Test
VOC	volatile organic compound
WAG	waste area group

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1. INTRODUCTION

Groundwater samples from the Snake River Plain Aquifer beneath the Waste Area Group (WAG) 5 were collected and analyzed in Fiscal Year (FY) 2002 in accordance with the requirements delineated in the *Groundwater Monitoring Plan for the Waste Area Group 5, Remedial Action* (U.S. Department of Energy Idaho Operations Office [DOE-ID] 2000a), hereinafter referred to as the Groundwater Monitoring Plan. Groundwater monitoring is being conducted in partial satisfaction of the requirements set forth in the *Final Record of Decision for Power Burst Facility and Auxiliary Reactor Area* (DOE-ID 2000b), which was signed in February 2000. This FY 2002 report is the second annual report following the signature of the Record of Decision (ROD).

As required in the ROD, groundwater monitoring is being conducted to reduce the uncertainties associated with previous sampling efforts and to provide trend data to assess the possibility that an unidentified source of lead contamination is affecting the aquifer. Specifically, samples have been collected to monitor the Snake River Plain Aquifer underlying the WAG 5 site to confirm that surface contaminants at the sites have not adversely affected the groundwater. Samples were collected for additional analyses to provide data in support of the five-year review for WAG 5 and the WAG 10, OU 10-08 Sitewide evaluation of the Snake River Plain Aquifer.

1.1 Purpose

In accordance with the Groundwater Monitoring Plan (DOE-ID 2000a), this document has been written to present groundwater monitoring data collected during FY 2002 as well as historical data for the wells covered under the Groundwater Monitoring Plan. The data presented herein supplement the groundwater monitoring data previously presented in the *Waste Area Group 5 Operable Unit 5-12 Comprehensive Remedial Investigation/Feasibility Study* (RI/FS) (DOE-ID 1999) and are a compilation of the data for the potential contaminants in the WAG 5 groundwater. The purpose of this document is to present and summarize data regarding contaminant concentrations in the groundwater. Conclusions regarding trends and discussion of the trends have been developed in Section 4.1 of this document.

1.2 Groundwater Monitoring Requirements

Based on hydraulic data, a groundwater contour map of the WAG 5 and surrounding area, it was determined during the RI/FS that there were a sufficient number of existing wells in appropriate locations to allow evaluation of the potential migration of groundwater contaminants. Of particular interest was the area downgradient of the Power Burst Facility (PBF) corrosive waste and warm-waste shallow injection wells. Upon review of the groundwater contour map during the RI/FS, it appeared that the production well Special Power Excursion Reactor Test (SPERT) I would provide relatively near-source downgradient data source regarding the impact these disposal wells have on water quality beneath WAG 5. In addition, wells in the Auxiliary Reactor Area (ARA) and PBF areas could be used to provide sufficient crossgradient coverage of the Snake River Plain Aquifer underlying WAG 5.

Table 1 provides a summary of the construction details for each of the WAG 5 groundwater monitoring wells. Each of the wells will be sampled on an annual basis until the first five-year review for the Operable Unit 5-12 ROD (DOE-ID 2000b). In addition, groundwater elevation measurements will be collected from monitoring wells other than the SPERT-I production well, which cannot be measured because of continuous use. Based on the results of the five-year review, the DOE-ID, U.S. Environmental Protection Agency (EPA), and Idaho Department of Environmental Quality will determine whether continued groundwater monitoring will be required at WAG 5.

Table 1. Summary of well information for WAG 5 groundwater monitoring wells.

Well Name	Total Depth (ft)	Monitoring Point Elevation (ft)	Screened Interval(s) Below Land Surface (ft)	Screen Type
ARA-MON-A-001	650	5037.00	620–640	Wire-wrapped
ARA-MON-A-002	629	5039.90	600–620	Wire-wrapped
ARA-MON-A-03A	655	5052.70	624–644	Wire-wrapped
ARA-MON-A-004	665	6057.00	625–645	Wire-wrapped
PBF-MON-A-001	495	4908.17	454–484	Wire-wrapped
PBF-MON-A-003	605	4961.13	545–575	Wire-wrapped
PBF-MON-A-004	545	4942.42	522–542	Wire-wrapped
PBF-MON-A-005	545	4977.98	516–536	Wire-wrapped
SPERT-I	653	N/A	482–492	Perforated
			522–542	Perforated
			552–582	Perforated
			597–617	Perforated
			632–652	Perforated

2. ANALYTICAL REQUIREMENTS

During FY 2002, organic, inorganic, and radionuclide samples were collected and analyzed, as discussed in the following sections. The analyses were performed in accordance with established Idaho National Engineering and Environmental Laboratory (INEEL) and EPA methods, with the exception of radionuclide analyses. The radionuclide analyses were performed in accordance with the requirements delineated in the *Idaho National Engineering Laboratory Sample Management Office Statement of Work for Radionuclide Analysis* (INEL 1995). This statement of work establishes the minimum required detection limits and quality assurance requirements for the analytical methods to be employed. All analytical results were validated to resident procedures established by the INEEL Sample Management Office (SMO).

2.1 Organic Analyses

The volatile organic compound (VOC) analyses were performed in accordance with SW-846 Method 8260B. Trichloroehtene was detected in well ARA-MON-A-004 at a concentration of 1.1 µg/L. This concentration is below the EPA defined maximum concentration level (MCL) of 5 µg/L for Trichloroethene. In addition, Chloroform was detected in the trip blank at 4.5 µg/L, and Tetrachloloehtene was detected in the equipment rinsate at 23 µg/L. These analytes are included in the individual well summaries in Appendix A, and the data for the complete list of VOCs is included in Appendix D.

2.2 Inorganic Analyses

Inorganic analyses included metals and anions. Metals analyses were performed in accordance with procedures delineated in SW-846. Specifically, mercury by SW-846 Method 7470A, silver by SW-846 Method 7760A, and the balance by SW-846 Method 3010A and SW-846 Method 6010B. Specific metals requested included arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Anion analysis included fluoride, chloride, bromide, nitrate, nitrite, orthophosphate, and sulfate. The sample analyses were performed in accordance with SW-846 Method 9056. As has occurred historically, lead is the only inorganic analyte to exceed an EPA-defined regulatory action level (15 µg/L for lead). Groundwater analytical samples that exceed the 15 µg/L action level were collected from wells ARA-MON-A-03A (15.6 µg/L), ARA-MON-A-004 (17.0 µg/L), and PBF-MON-A-004 (17.1 µg/L). Figure 1 shows lead concentrations in the individual wells. The metals and anion historical results are summarized in Appendix A for the individual wells.

Excluding the production well SPERT I, each of the WAG 5 groundwater monitoring wells were installed with galvanized discharge, and water access pipes. As part of the INEEL routine well maintenance program, pumps were removed and maintained, and galvanized pipe were removed and replaced with stainless steel pipe in wells ARA-MON-A-002, ARA-MON-A-03A, and ARA-MON-A-004 during June of 2002. Galvanized pipe removed from these wells showed evidence of corrosion, and rusting. In addition to lead in samples from these wells, elevated levels of zinc (although below the 5 mg/L SMCL for zinc), were also present in the samples.

Corrosion of galvanized pipes has been attributed to the presence of lead and zinc in groundwater samples from other wells located at the INEEL, specifically, wells in the CFA area. Following replacement of galvanized pipe with stainless steel pipe in other INEEL wells, the concentrations of lead and zinc were decreased. In addition, galvanized piping in wells PBF-MON-A-001, and PBF-MON-A-005, was replaced with stainless steel pipe in August of 2000, resulting in decreased lead concentrations in these wells. Consequently, the elevated lead and zinc concentrations in the ARA wells are probably the result of corroded galvanized pipe in the wells. With the replacement of galvanized pipe with stainless steel pipe, the lead concentration is likely to decrease.

2.3 Radionuclide Analyses

Radionuclide analyses included gross alpha and beta, gamma spectrometric, tritium, and iodine-129. The analyses were performed in accordance with the requirements delineated in the INEEL radionuclide analytical statement of work (INEL 1995). For the FY 2002 sampling effort, the laboratory was requested to perform alpha and beta isotopic analyses if the corresponding gross alpha or gross beta sample result exceeded 5 pCi/L. Because this did not occur for any of the well samples analyzed, it was not necessary to perform the isotopic tests. None of the analytes exceeded the EPA-defined maximum contaminant levels (MCLs) for drinking water. However, the MCL for iodine-129 is 1 pCi/L, and the method detection limit employed by the laboratory was approximately 1 pCi/L. Consequently, six samples failed to meet the minimum detectable activity, but each was flagged "U" and considered undetected at the method detection limit employed. These samples were collected from ARA-MON-A-001, ARA-MON-A-002 (including the duplicate sample from this well), ARA-MON-A-03A, PBF-MON-A-003, and SPERT-I. The radionuclide analytical data are summarized in Appendix A for the individual wells.

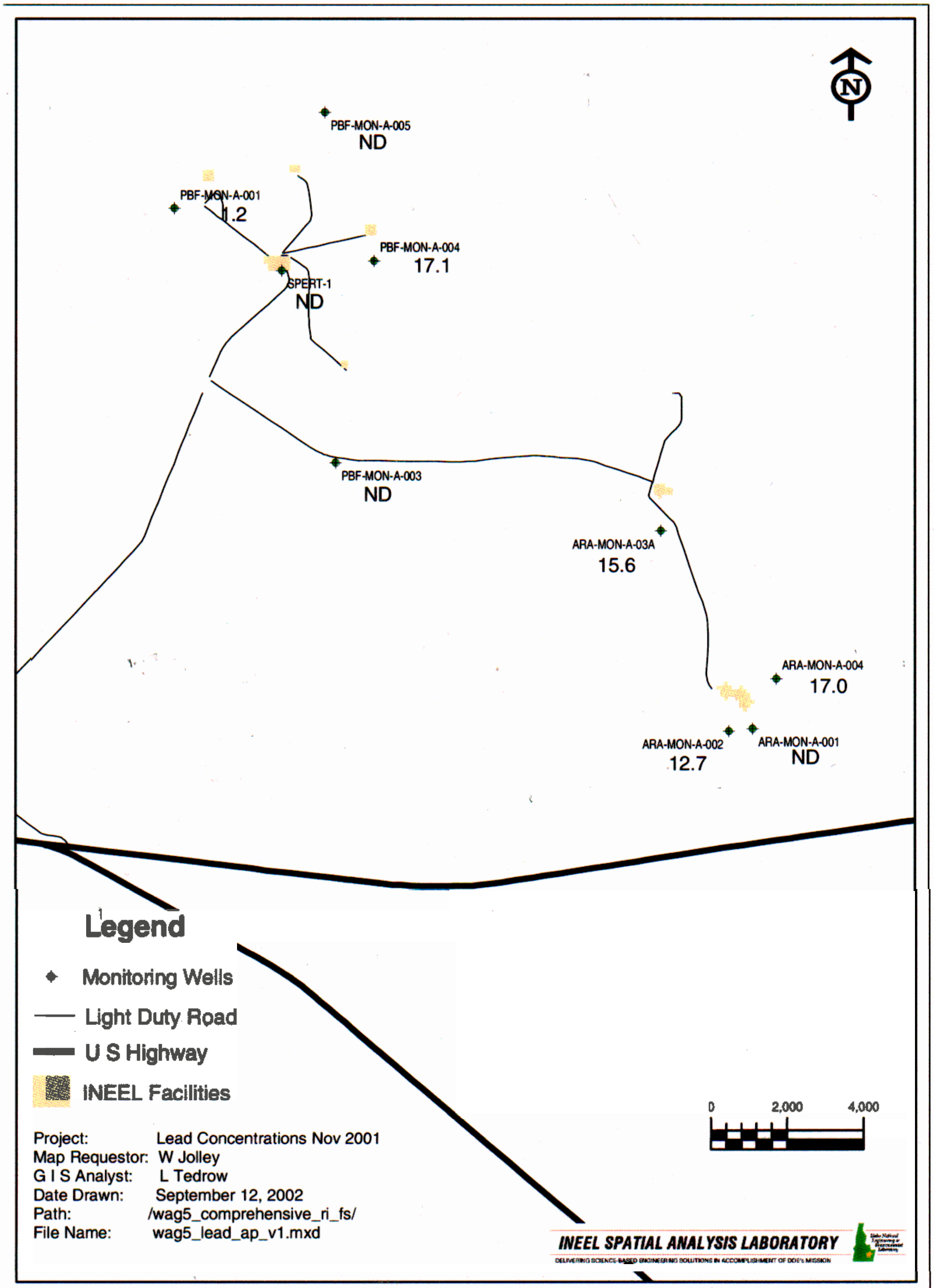

Figure 1. Well locations with lead concentrations.

3. GROUNDWATER QUALITY AND TRENDS

3.1 Overall Quality

The greatest measure of overall quality of the groundwater underlying WAG 5 is the comparison of the analytical data to the MCLs as defined by the EPA. Table 2 summarizes the minimum, maximum, and average results from the FY 2002 sampling round. This table also shows the background concentrations at the INEEL for the identified analytes. Results are presented only for those analytes that had at least one true positive detection. However, nondetections were calculated into the average by using a value of one half of the detection limit for the sample concentration. Only arsenic, chromium, lead, and selenium were detected at concentrations above background concentrations. Of these analytes, only lead was detected at concentrations above MCL's, or EPA action level.

Table 2. WAG 5 groundwater quality summary.

Analyte	Background[d]	Maximum	Minimum	Average Including Non Detects[e]	Number of Samples with Detections	Number of Samples	MCL
Gross beta (pCi/L)	0 to 7	4.38	1.59	2.11	10	10	50
Arsenic (μg/L)	2 to 3	9	ND (<3.3)	3.86	6	10	50
Barium (μg/L)	50 to 70	59.5	30.4	43.33	10	10	2000
Cadmium (μg/L)	< 1	2.3	ND (<0.3)	0.68	1	10	5
Chromium (μg/L)	2 to 3	8.5	2.5	6.00	10	10	100
Lead (μg/L)	1 to 5	17.1	ND (<1.2)	7.43	5	10	15[a]
Selenium (μg/L)	< 1	7.7	ND (<0.8)	2.41	4	10	50
Fluoride (mg/L)	0.4 to 0.5	0.416	0.16	0.26	10	10	4[b]
Chloride (mg/L)	16 to 27	24.2	13.7	18.46	10	10	250[c]
Nitrate (mg/L)	1 to 2	1.14	0.227	0.82	10	10	10
Sulfate (mg/L)	24 to 31	23.9	16.3	20.41	10	10	250[c]

a. Concentration represents the EPA-defined action level for this contaminant.

b. For fluoride, there exists a 2mg/L secondary standard in addition to the MCL.

c. Concentration represents the EPA-defined secondary standard for this contaminant.

d. Background concentrations are from Knobel, Orr, and Cecil (1992).

e. Non detects were calculated into the average using half of the detection limit.

ND = not detected

3.2 Trend Analysis

Lead concentrations versus time were plotted for each of the nine WAG 5 monitoring wells, and are included in Appendix B. Only lead concentrations versus time were graphed because it is the only analyte in the samples that approached or exceeded the MCL or action level. Statistical trend analysis was performed on the lead concentration from wells ARA-MON-A-001, ARA-MON-A-002, ARA-MON-A-03A, ARA-MON-A-004, PBF-MON-A-001, and PBF-MON-A-004 because only these wells had enough positive detectable lead concentrations upon which the statistical tests could be performed.

For the WAG 5 groundwater monitoring, a 95% significance level was used to determine whether a trend in the data exists. Calculated statistical parameters included the correlation coefficient (r), the r^2 value, the p-value, and the slope.

Lead data from each well was evaluated against the calculated regression coefficients to determine whether a significant statistical trend exists. The correlation coefficient and the r^2 value indicate how well the regression line fits the data. In general, a correlation coefficient close to one or negative one, and r^2 values close to one indicate a good fit of the regression line to the data. The direction of the trend may be ascertained based on whether the correlation coefficient (r) is positive or negative. At the 95% confidence interval, a P-value of less than 0.05 indicates whether or not a statistically significant trend exists.

Based upon the comparison of the calculated regression coefficients, only well PBF-MON-A-004 shows that there may be a trend in the lead data. With a correlation coefficient of 0.81, and a P-value of 0.051, it appears that there may be an increasing trend in the lead concentration in this well. However, additional sampling rounds will provide greater insight as to whether or not a trend truly does exist.

NOTE: *Well PBF-MON-A-004 contains galvanized discharge, and water level pipe. It is likely that corrosion of the pipe is the reason for the elevated lead concentrations in this well. Consequently, PBF-MON-A-004 would be a good candidate for replacement of the galvanized pipe. If this is done, it is likely that the lead concentrations will fall into the range of the background concentrations.*

Table 3 provides a summary of the calculated regression coefficients (at the 95% confidence interval) for the lead data from each well. Sample results less than the reporting limit were not used to calculate the regression coefficients. It should be noted that these data sets are limited, and any statistical inferences based upon the data may be premature.

Table 3. Statistical trend analysis.

Well	Slope	Correlation Coefficient	P-value	Significant Statistical Trend	R^2
ARA-MON-A-001	0.0075	0.260	0.573	No	0.068
ARA-MON-A-002	0.0016	0.617	0.267	No	0.381
ARA-MON-A-03A	-0.0001	0.635	0.948	No	0.001
ARA-MON-A-004	0.0012	0.072	0.892	No	0.005
PBF-MON-A-001	-0.0016	0.617	0.267	No	0.146
PBF-MON-A-004	0.0063	0.810	0.051	Yes (marginal)	0.656

3.3 Groundwater Level Measurements

In addition to the groundwater sampling, water level measurements were obtained from the WAG 5 monitoring wells at the time that they were sampled. However, the water level measurement collected from well PBF-MON-A-005 at the time it was sampled is considered to be inaccurate due to difficulties encountered while collecting the measurement. At the time the water level measurement was collected from PBF-MON-A-005, the water level detector would not reach the water table through the water access line. Moisture on the inside of the pipe was causing the tape to stick to the pipe above the water table. Repeated attempts to collect a depth to water measurement through the water access line failed to produce a measurement. Consequently, the water level measurement was collected through the discharge pipe connected to the pump. This method resulted in a depth to water measurement approximately 60 ft shallower than historical measurements. The probable explanation for the anomalously shallow water measurement is the check valve in the pump didn't allow water to completely drain from the pipe after the last sampling event. As a result, water was standing in the pipe above the depth of the water table. Furthermore, because the SPERT I production well is in continuous use, groundwater level measurements cannot be obtained from the well.

Although all of the water level measurements were collected from all of the wells required by the Groundwater Monitoring Plan, these wells alone do not provide sufficient data coverage to delineate the water table beneath WAG 5. Water level measurements from wells in the area surrounding WAG 5 need to be utilized to provide accurate data points beyond the WAG 5 vicinity that the groundwater contours can be tied to. Water level measurements were not collected from most of the wells in the area surrounding WAG 5 during November 2001. However, water level measurements were collected from WAG 5, and surrounding area wells during July 2001. Consequently, water level measurements from July 2001 were used to construct the groundwater contour map illustrated in Figure 2. A second map (see Figure 3) was prepared showing the well locations and water table elevations from the November waterlevel data.

Well Site 9 is screened at a depth of approximately 1,000 ft below land surface, and lithologic data suggests that the deep portion of the aquifer in the WAG 5 area may be confined or semiconfined. As a result, water level elevations from Site 9 are consistently 10–15 ft above those from nearby wells. Therefore, water level elevations from this well were not included on the groundwater contour map.

The groundwater contour map was initially generated by hand contouring the water level elevation data from the WAG 5 and surrounding area wells. Water level data was subsequently entered into the mapping software, Surfer, which generated contours of the data that then were reviewed for correlation with the hand generated contours. The Surfer-generated map was an adequate recreation of the hand generated contours and was therefore used in this report. Historical groundwater elevations for the WAG 5 monitoring wells, including July 2001 and November 2001 data, are summarized in Table 4.

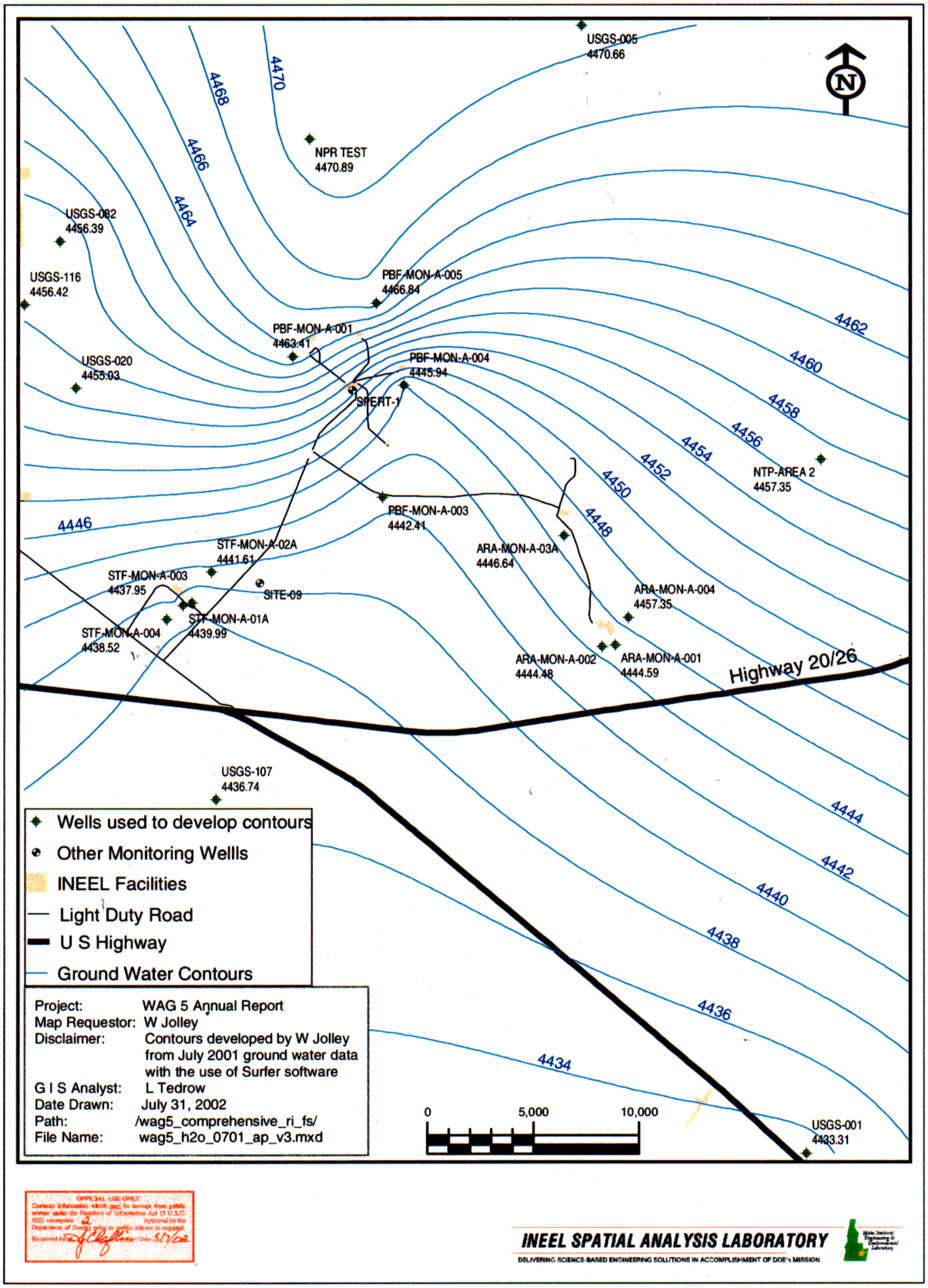

Figure 2. WAG 5 groundwater contour map.

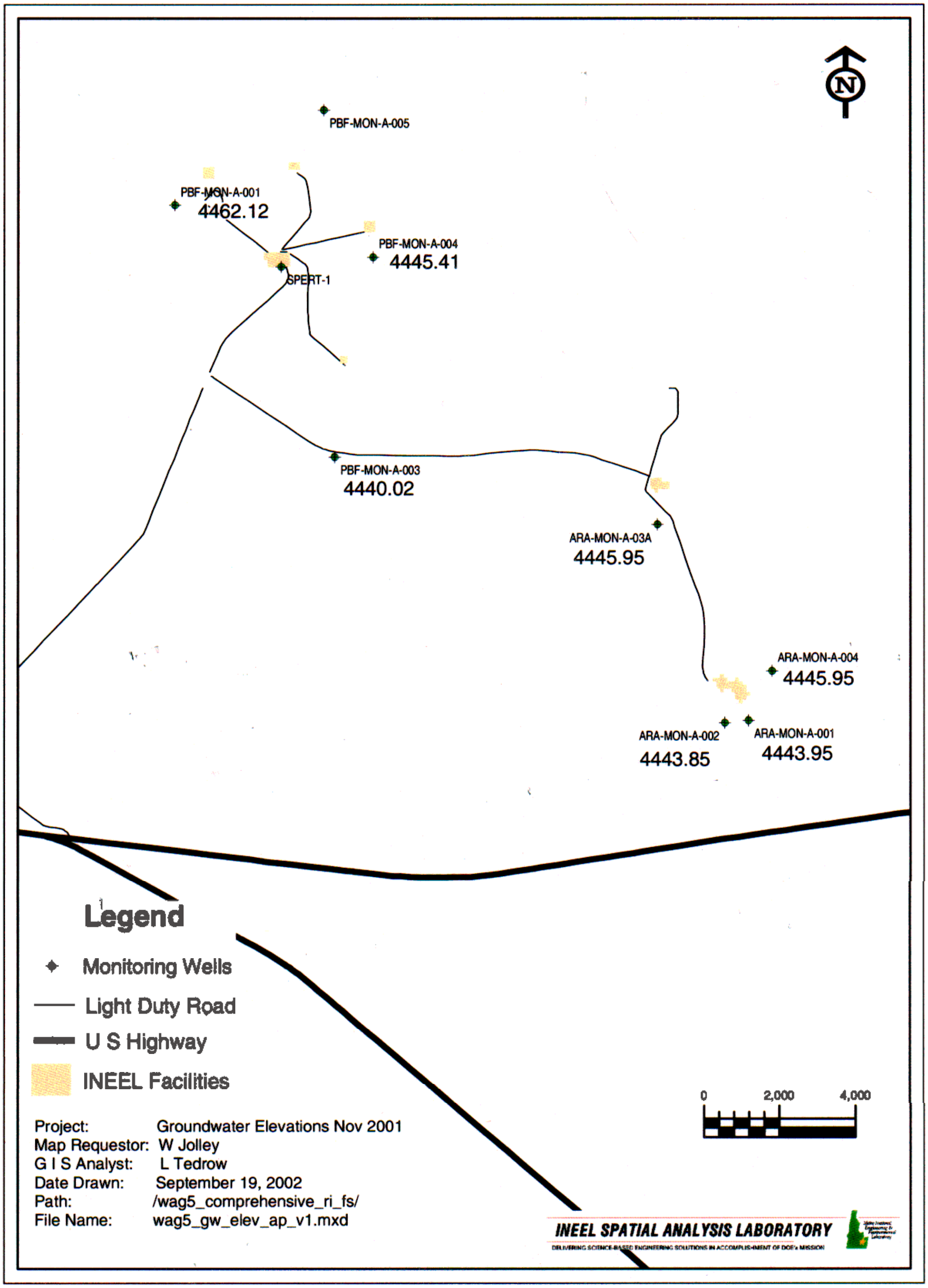

Figure 3. Well locations with November 2001 water level measurements.

Table 4. WAG 5 groundwater elevations.

Well	Third Quarter 1996		Fourth Quarter 1996		First Quarter 1997		Fourth Quarter 2000		July 2001		November 2001	
	Depth (ft)	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)	Elevation (ft)
ARA-MON-A-001	592.06	4444.94	592.36	4444.64	591.67	4445.33	591.48	4445.52	589.71	4444.59	593.05	4443.95
ARA- MON-A-002	595.06	4444.84	595.34	4444.56	594.67	4445.23	594.48	4445.42	592.92	4444.48	596.05	4443.85
ARA- MON-A-003A	605.90	4446.80	606.17	4446.53	605.45	4447.25	605.16	4447.54	603.46	4446.64	606.75	4445.95
ARA- MON-A-004	620.10	4446.90	620.38	4446.62	619.67	4447.33	619.42	4447.58	617.91	4446.69	621.05	4445.95
PBF- MON-A-001	447.51	4460.66	448.15	4460.02	447.58	4460.59	443.99	4464.18	442.74	4463.41	446.05	4462.12
PBF- MON-A-003	520.37	4440.76	518.50	4442.63	517.97	4443.16	517.98	4443.15	516.88	4442.41	521.11	4440.02
PBF- MON-A-004	496.50	4445.92	497.18	4445.24	496.45	4445.97	495.52	4446.90	493.72	4445.94	497.01	4445.41
PBF- MON-A-005	513.63	4464.35	514.42	4463.56	512.94	4465.04	510.38	4467.60	509.29	4466.84	450.21[a]	4527.11

a. Water level measurement could not be obtained through the water access pipe, but was collected through the discharge pipe. Measurement is anomalously shallow.

4. CONCLUSIONS AND RECOMMENDATIONS

The following sections summarize the conclusions and recommendations based on the groundwater monitoring events that have occurred to date.

4.1 Conclusions

Groundwater monitoring for FY 2002 was completed during November 2001 in accordance with the requirements delineated in the WAG 5 ROD (DOE-ID 2000b) and the Groundwater Monitoring Plan (DOE-ID 2000a). As discussed in Appendix C, the data quality objectives defined in the Groundwater Monitoring Plan (DOE-ID 2000a) were met. With the exception of lead, all constituents analyzed from the groundwater samples collected during the November 2001 sampling event were below MCLs. Lead exceeded the EPA action level of 15 µg/L in wells ARA-MON-A-03A (15.6 µg/L), ARA-MON-A-004 (17.0 µg/L), and PBF-MON-A-004 (17.1 µg/L). Elevated lead concentrations in these wells are considered to be the result of corroded galvanized pipe. However, during June 2002, the corroded galvanized pipe in wells ARA-MON-A-03A and ARA-MON-A-004 was replaced with stainless steel pipe. Consequently, it is anticipated that the lead concentrations in these wells will decrease in future sampling events. Galvanized pipe has not been replaced in well PBF-MON-A-004. It is likely that when the galvanized pipe is replaced in this well, that the lead concentration will decrease to approximately background concentrations. Overall, the analyte concentrations appear to remain consistent with the results obtained historically

The groundwater contour map plotted from the water level elevations measured during July 2001 continues to show a general (regional) southwesterly flow direction consistent with previous maps. The groundwater contours do show a local variation in flow in the area of the PBF.

4.2 Recommendations

Groundwater monitoring is recommended to continue at the nine wells utilized by WAG 5 at the frequency prescribed in the Groundwater Monitoring Plan (DOE-ID 2000a).

For overall comparability of the groundwater analytical data, it is recommended that groundwater samples for WAG 5 continue to be collected at approximately the same time of year for each annual event. WAG 5 is currently scheduled to be sampled annually during November of each year.

In order to accurately evaluate water level measurements, and therefore, to generate accurate groundwater contour maps, it is necessary to include data from wells in an area surrounding WAG 5. As a result, it is recommended that the number of wells from which water level measurements are collected for WAG 5 be expanded to include the thirteen wells identified in Table 5.

Table 5. Proposed wells for additional WAG 5 groundwater level measurements.

Well Name	Well ID	General Location
STF-MON-A-01A	998	South of PBF, West of ARA
STF-MON-A-02A	999	South of PBF, West of ARA
STF-MON-A-003	1005	South of PBF, West of ARA
STF-MON-A-004	1007	South of PBF, West of ARA
USGS-001	450	South of Highway 26, South of PBF
USGS-005	454	Northeast of PBF
USGS-020	462	West of PBF, between PBF and Lincoln Blvd.
USGS-082	531	West of PBF, between INTEC and PBF
USGS-107	556	South of Highway 26, South of PBF
USGS-110	559	South of Highway 26, South of PBF
USGS-116	565	West of PBF, between INTEC and PBF
NPR TEST	239	North of PBF
NTP AREA 2	245	East of ARA

5. REFERENCES

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Appendix A

Individual Well Summary Tables

Appendix A
Individual Well Summary Tables

ARA-MON-A-001

Historical Data Range 1995-2000		Sample Number: 5GM10101 Date Sampled: 11/6/01		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
4.3	ND	Gross Alpha	1.77	U
4.62	2.71	Gross Beta	3.16	U
		Gamma Spec. (pCi/L)		
ND	ND	Co-60	3.49	U
ND	ND	Cs-137	3.14	U
ND	ND	Tritium (pCi/L)	3.14	U
ND	ND	Iodine-129 (pCi/L)	1.24	U
		Metals (ug/L)		
141	ND	Aluminum	NS	
ND	ND	Antimony	NS	
2.9	ND	Arsenic	3.3	U
37.7	31.7	Barium	36.9	
ND	ND	Beryllium	NS	
ND	ND	Cadmium	1.9	U
3.9	ND	Chromium	2.7	B UJ
ND	ND	Copper	NS	
95.5	ND	Iron	NS	
13.8	5.7	Lead	11.9	
ND	ND	Manganese	NS	
ND	ND	Mercury	0.10	U
ND	ND	Selenium	4.7	B U
ND	ND	Silver	0.9	U
ND	ND	Thallium	NS	
634	438	Zinc	NS	

Historical Data Range 1995-2000		Sample Number: 5GM10101 Date Sampled: 11/6/01		
Maximum	Minimum	Analysis		Flag
		Anions (mg/L)		
20.8	17.8	Chloride	18.6	UJ
0.511	0.4	Fluoride	0.421	B
6	1.14	Nitrate	1.08	
0.2	ND	Nitrite	0.1	U
1.2	1.1	Nitrate/Nitrite	NS	
20.2	17	Sulfate	19.9	UJ
		Organics[a] (ug/L)		
		Chloroform	5	U
		Trichloroethene	5	U
		Tetrachloroethene	23	

ARA-MON-A-002

Historical Data Range 1995-2000		Sample Number: 5GM00202 (DUP) Date Sampled: 11/5/01			Sample Number: 5GM10201 Date Sampled: 11/5/01	
Maximum	Minimum	Analysis		Flag	Analysis	Flag
		Gross Alpha/Beta (pCi/L)				
2.42	ND	Gross Alpha	1.57	U	2.28	U
3.86	ND	Gross Beta	1.41+/- 0.35		2.03 +/- 0.37	
		Gamma Spec. (pCi/L)				
ND	ND	Co-60	3.53	U	4.58	U
ND	ND	Cs-137	3.36	U	4.58	U
ND	ND	Tritium (pCi/L)	290	U	290	U
ND	ND	Iodine-129 (pCi/L)	1.37	U	1.27	U
		Metals (ug/L)				
ND	ND	Aluminum	NS		NS	
ND	ND	Antimony	NS		NS	
ND	ND	Arsenic	3.3	U	9.0	B
36.5	31.5	Barium	39.4		43.7	
ND	ND	Beryllium	NS		NS	
ND	ND	Cadmium	1.9	U	2.3	B
3.9	3.2	Chromium	2.5	B J	6.1	
ND	ND	Copper	NS		NS	
61.2	ND	Iron	NS		NS	
13	6.2	Lead	8.1	B U	12.7	
ND		Manganese	NS		NS	
0.03	ND	Mercury	0.1	U	0.1	U
2.6	ND	Selenium	2.8	U	4.8	B
ND	ND	Silver	3.7	B U	2.3	B
ND	ND	Thallium	NS		NS	
694	455	Zinc	NS		NS	
		Anions (mg/L)				
20	18.2	Chloride	18.7	J	17.4	J
0.521	0.4	Fluoride	0.416	B	0.399	B
5.9	1.15	Nitrate	1.08		1.02	
0.2	ND	Nitrite	0.1	U J	0.1	U R
1.2	1.2	Nitrate/Nitrite			NS	
21.2	18.1	Sulfate	19.8		18.6	J
		Organics (ug/L)				
ND	ND	Chloroform	5	U	4.5	J
ND	ND	Trichloroethene	5	U	5	U
ND	ND	Tetrachloroethene	5	U	5	U

ARA-MON-A-03A

Historical Data Range 1995-2000		Sample Number: 5GM10301 Date Sampled: 11/6/01		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
ND	ND	Gross Alpha	1.81	U
4.50	ND	Gross Beta	1.74 +/- 0.32	
		Gamma Spec. (pCi/L)		
ND	ND	Co-60	4.71	U
ND	ND	Cs-137	4.85	U
ND	ND	Tritium (pCi/L)	293	U
ND	ND	Iodine-129 (pCi/L)	1.23	U
		Metals (ug/L)		
ND	ND	Aluminum	NS	
ND	ND	Antimony	NS	
2.6	ND	Arsenic	4.2	B
40.6	36.3	Barium	42.8	
ND	ND	Beryllium	NS	
ND	ND	Cadmium	1.9	U
4.3	ND	Chromium	3.8	B J
ND	ND	Copper	NS	
109	ND	Iron	NS	
22.2	11	Lead	15.6	
2.8	1.6	Manganese	NS	
0.03	ND	Mercury	0.1	U
2.3	ND	Selenium	2.8	U
ND	ND	Silver	0.9	U
ND	ND	Thallium	NS	
1110	503	Zinc	NS	
		Anions (mg/L)		
23.9	20.6	Chloride	20.2	J
0.481	0.4	Fluoride	0.368	B

Historical Data Range 1995-2000		Sample Number: 5GM10301 Date Sampled: 11/6/01		
Maximum	Minimum	Analysis		Flag
5.8	1.29	Nitrate	1.14	
0.2	ND	Nitrite	0.1	U
1.4	1.3	Nitrate/Nitrite	NS	
22	21	Sulfate	20.5	J
		Organics (ug/L)		
ND	ND	Chloroform	5	U
ND	ND	Trichloroethene	5	U
ND	ND	Tetrachloroethene	5	U

ARA-MON-A-004

Historical Data Range 1995-2000		Sample Number: 5GM10401 Date Sampled: 11/6/01		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
2.18	ND	Gross Alpha	1.75	U
3.28	ND	Gross Beta	1.59 +/- 0.36	
		Gamma Spec. (pCi/L)		
ND	ND	Co-60	3.83	U
ND	ND	Cs-137	2.9	U
ND	ND	Tritium (pCi/L)	289	U
ND	ND	Iodine-129 (pCi/L)	0.82	U
		Metals (ug/L)		
ND	ND	Aluminum	NS	
ND	ND	Antimony	NS	
3.4	ND	Arsenic	3.3	U
38.3	32.7	Barium	38.4	
ND	ND	Beryllium	NS	
0.3	ND	Cadmium	1.9	U
37	ND	Chromium	2.8	B J
4.4	ND	Copper	NS	
16600	ND	Iron	NS	
49.2	5.9	Lead	17.0	
33.5	1.7	Manganese	NS	
0.03	ND	Mercury	0.1	U
2.8	ND	Selenium	7.7	B U
ND	ND	Silver	0.9	U
ND	ND	Thallium	NS	
4030	643	Zinc	NS	
		Anions (mg/L)		
21.5	17.7	Chloride	17.8	J
0.542	0.3	Fluoride	0.387	B

Historical Data Range 1995-2000		Sample Number: 5GM10401 Date Sampled: 11/6/01		
Maximum	Minimum	Analysis		Flag
5.2	1.08	Nitrate	1.03	
0.2	ND	Nitrite	0.1	U
1.2	1.2	Nitrate/Nitrite	NS	
20.8	19	Sulfate	18.9	J
		Organics (ug/L)		
ND	ND	Chloroform	5	U
ND	ND	Trichloroethene	1.1	J
ND	ND	Tetrachloroethene	5	U

PBF-MON-A-001

Historical Data Range 1995-2000		Sample Number: 5GM10501 Date Sampled: 11/13/01		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
3.3	ND	Gross Alpha	3.28 +/- 0.45	
3.8	ND	Gross Beta	4.38 +/- 0.43	
		Gamma Spec. (pCi/L)		
ND	ND	Co-60	5.48	U
ND	ND	Cs-137	5.05	U
879	ND	Tritium (pCi/L)	257	U
ND	ND	Iodine-129 (pCi/L)	0.84	U
		Metals (ug/L)		
ND	ND	Aluminum	NS	
ND	ND	Antimony	NS	
ND	ND	Arsenic	3.4	B
37.1	26.1	Barium	33.8	
ND	ND	Beryllium	NS	
ND	ND	Cadmium	0.3	U
5.5	ND	Chromium	6.4	
ND	ND	Copper	NS	
320	ND	Iron	NS	
13.6	1	Lead	1.6	U
14.3	13.1	Manganese	NS	
0.03	ND	Mercury	0.1	U
ND	ND	Selenium	0.8	U UJ
ND	ND	Silver	0.7	U UJ
ND	ND	Thallium	NS	
955	849	Zinc	NS	
		Anions (mg/L)		
17.77	15.9	Chloride	14.8	
0.275	0.2	Fluoride	0.16	B

Historical Data Range 1995-2000		Sample Number: 5GM10501 Date Sampled: 11/13/01		
Maximum	Minimum	Analysis		Flag
1.6	0.35	Nitrate	0.227	B
0.2	ND	Nitrite	0.1	U
0.34	0.28	Nitrate/Nitrite	NS	U
18.9	17.4	Sulfate	16.3	J
		Organics (ug/L)		
ND	ND	Chloroform	5	U
ND	ND	Trichloroethene	5	U
ND	ND	Tetrachloroethene	5	U

PBF-MON-A-003

Historical Data Range 1995-2000		Sample Number: 5GM10601 Date Sampled: 11/5/01		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
1.79	ND	Gross Alpha	1.37	U
2.72	ND	Gross Beta	2.20 +/- 0.35	
		Gamma Spec. (pCi/L)		
ND	ND	Co-60	3.7	U
ND	ND	Cs-137	3.56	U
ND	ND	Tritium (pCi/L)	272	U
ND	ND	Iodine-129 (pCi/L)	1.2	U
		Metals (ug/L)		
ND	ND	Aluminum	NS	
ND	ND	Antimony	NS	
3	ND	Arsenic	3.3	U
51.8	43.4	Barium	59.5	
ND	ND	Beryllium	NS	
ND	ND	Cadmium	1.9	U
16.5	5.2	Chromium	8.5	
ND	ND	Copper	NS	
62	ND	Iron	NS	
7.1	ND	Lead	1.2	U
3.4	ND	Manganese	NS	
0.03	ND	Mercury	0.1	U
ND	ND	Selenium	5.3	B U
ND	ND	Silver	2.1	B U
ND	ND	Thallium	NS	
38.9	8.8	Zinc	NS	
		Anions (mg/L)		
15.1	13.6	Chloride	12.4	J
0.319	0.2	Fluoride	0.219	B

Historical Data Range 1995-2000		Sample Number: 5GM10601 Date Sampled: 11/5/01		
Maximum	Minimum	Analysis		Flag
2.8	0.66	Nitrate	0.529	B
0.1	ND	Nitrite	0.1	U J
0.67	0.64	Nitrate/Nitrite	NS	
24	20.8	Sulfate	22.1	J
		Organics (ug/L)		
ND	ND	Chloroform	5	U
ND	ND	Trichloroethene	5	U
ND	ND	Tetrachloroethene	5	U

PBF-MON-A-004

Historical Data Range 1995-2000		Sample Number: 5GM10701 / Date Sampled: 11/13/01		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
2.19	ND	Gross Alpha	1.75 +/- 0.51	
1.58	ND	Gross Beta	2.55	U
		Gamma Spec. (pCi/L)		
ND	ND	Co-60	3.2	U
ND	ND	Cs-137	3.26	U
5010	ND	Tritium (pCi/L)	260	U
ND	ND	Iodine-129 (pCi/L)	0.64	U
		Metals (ug/L)		
ND	ND	Aluminum	NS	
ND	ND	Antimony	NS	
ND	ND	Arsenic	4.7	B
26.9	25.1	Barium	30.4	
ND	ND	Beryllium	NS	
ND	ND	Cadmium	0.3	U
7.1	ND	Chromium	8.3	
ND	ND	Copper	NS	
ND	ND	Iron	NS	
17.5	5.6	Lead	17.1	
ND	ND	Manganese	NS	
0.03	ND	Mercury	0.1	U
2.4	ND	Selenium	2.5	B J
ND	ND	Silver	0.7	U UJ
ND	ND	Thallium	NS	
609	533	Zinc	NS	
		Anions (mg/L)		
22	13.35	Chloride	21.2	J
0.23	ND	Fluoride	0.19	B

Historical Data Range 1995-2000		Sample Number: 5GM10701		
		Date Sampled: 11/13/01		
Maximum	Minimum	Analysis		Flag
2.2	0.51	Nitrate	0.561	B
ND	ND	Nitrite	0.1	U
NS	NS	Nitrate/Nitrite	NS	
22.8	18.18	Sulfate	18.7	J
		Organics (ug/L)		
ND	ND	Chloroform	5	U
ND	ND	Trichloroethene	5	U
ND	ND	Tetrachloroethene	5	U

PBF-MON-A-005

Historical Data Range 1997-2000		Sample Number: 5GM10801 / Date Sampled: 11/12/01		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
2.35	ND	Gross Alpha	1.51 +/- 0.45	
2.12	ND	Gross Beta	2.78 +/- 0.45	
		Gamma Spec. (pCi/L)		
ND	ND	Co-60	3.2	U
ND	ND	Cs-137	2.97	U
ND	ND	Tritium (pCi/L)	258	U
ND	ND	Iodine-129 (pCi/L)	0.75	U
		Metals (ug/L)		
ND	ND	Aluminum	NS	
ND	ND	Antimony	NS	
ND	ND	Arsenic	4.1	B
53.6	48.2	Barium	42.9	
ND	ND	Beryllium	NS	
ND	ND	Cadmium	0.3	U
6.6	6.3	Chromium	8.0	
8.5	ND	Copper	NS	
60.7	ND	Iron	NS	
12.7	1.1	Lead	1.6	U
3.4	ND	Manganese	NS	
ND	ND	Mercury	0.1	U J
2	ND	Selenium	0.8	U UJ
ND	ND	Silver	0.7	U UJ
ND	ND	Thallium	NS	
998	909	Zinc	NS	
		Anions (mg/L)		
16	14.6	Chloride	13.7	J
0.25	0.19	Fluoride	0.148	B

Historical Data Range 1997-2000		Sample Number: 5GM10801 Date Sampled: 11/12/01		
Maximum	Minimum	Analysis		Flag
3.2	0.69	Nitrate	0.571	B
ND	ND	Nitrite	0.1	U
NS	NS	Nitrate/Nitrite	NS	
22.2	21.08	Sulfate	21.4	J
		Organics (ug/L)		
ND	ND	Chloroform	5	U
ND	ND	Trichloroethene	5	U
ND	ND	Tetrachloroethene	5	U

SPERT-I

Historical Data Range 1997-2000		Sample Number: 5GM10901 Date Sampled: 11/12/01		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
2.35	ND	Gross Alpha	3.52 +/- 0.52	
3.33	ND	Gross Beta	2.00 +/- 0.52	
		Gamma Spec. (pCi/L)		
ND	ND	Co-60	5.07	U
ND	ND	Cs-137	4.14	U
ND	ND	Tritium (pCi/L)	277	U
ND	ND	Iodine-129 (pCi/L)	1.41	U
		Metals (ug/L)		
ND	ND	Aluminum	NS	
ND	ND	Antimony	NS	
ND	ND	Arsenic	4.1	B
53.6	48.2	Barium	51.2	
ND	ND	Beryllium	NS	
ND	ND	Cadmium	0.3	U
6.6	ND	Chromium	6.8	
8.5	ND	Copper	NS	
60.7	ND	Iron	NS	
30	ND	Lead	1.6	U
3.4	ND	Manganese	NS	
0.03	ND	Mercury	0.1	U
2	ND	Selenium	0.8	U UJ
ND	ND	Silver	0.7	U UJ
ND	ND	Thallium	NS	
60	7.8	Zinc	NS	
		Anions (mg/L)		
26.2	22.1	Chloride	24.2	J
0.287	0.2	Fluoride	0.178	B
6.2	1.02	Nitrate	1.01	
ND	ND	Nitrite	0.1	U
NS	NS	Nitrate/Nitrite	NS	

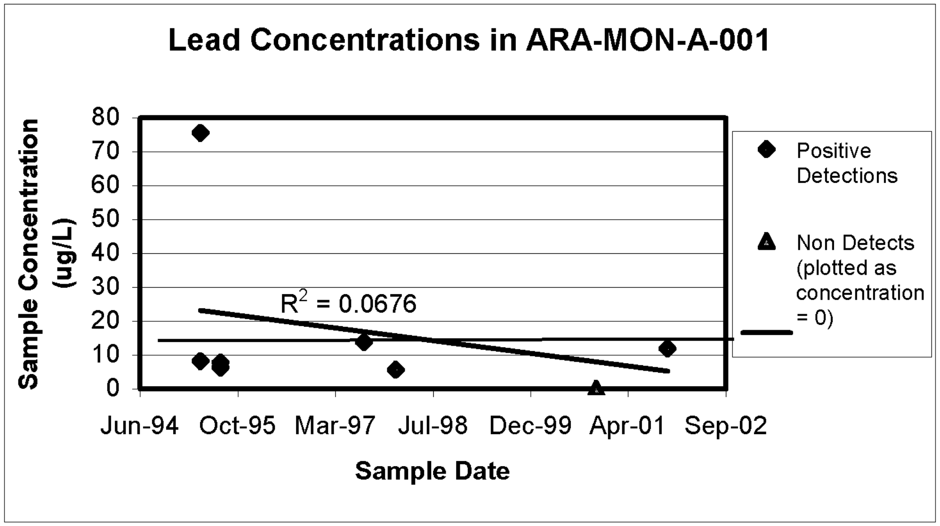
Historical Data Range 1997-2000		Sample Number: 5GM10901 Date Sampled: 11/12/01			
Maximum	Minimum	Analysis			Flag
26.1	22.34	Sulfate		23.9	J
		Organics (ug/L)			
ND	ND	Chloroform	5		U
ND	ND	Trichloroethene	5		U
ND	ND	Tetrachloroethene	5		U

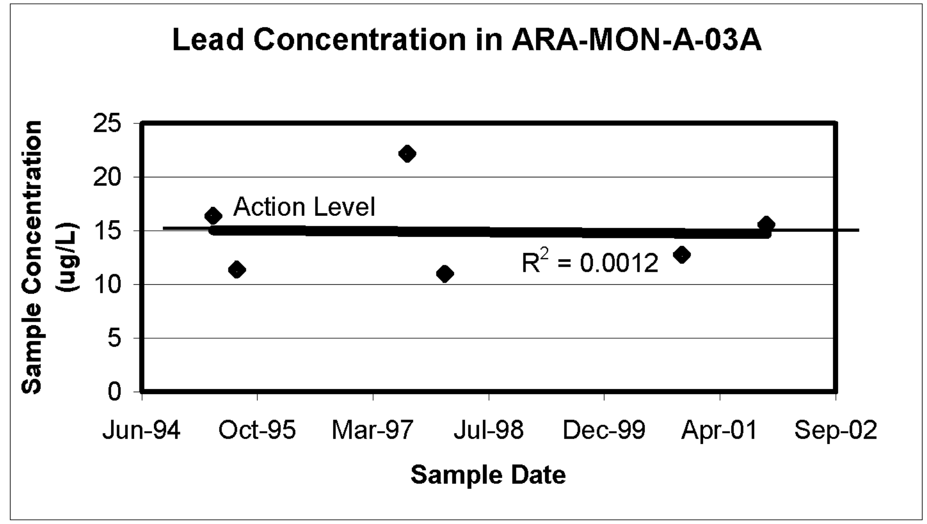
NS = Not samples
U = Constituent not detected at the method detection limit
J -= Estimated value
R = Rejected value
B =

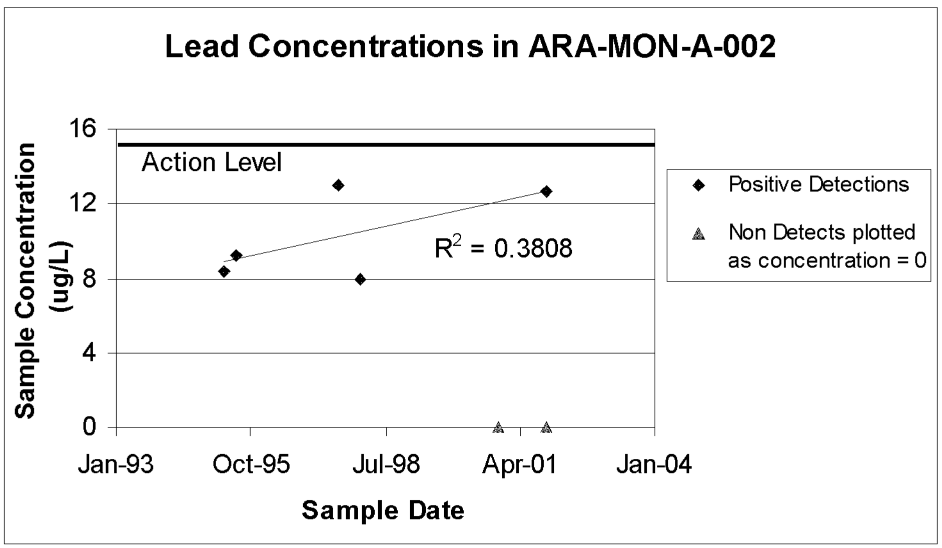
Appendix B

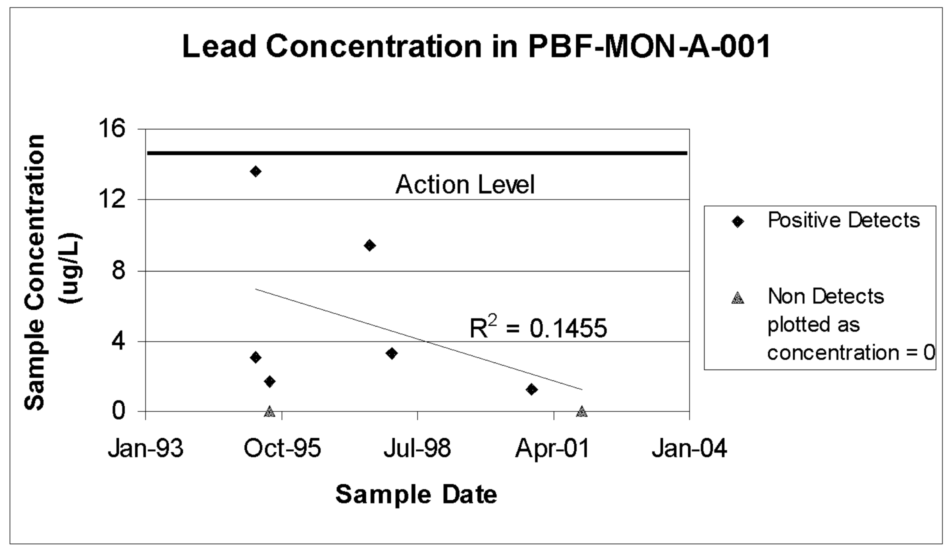
Lead Concentration Graphic Analyses

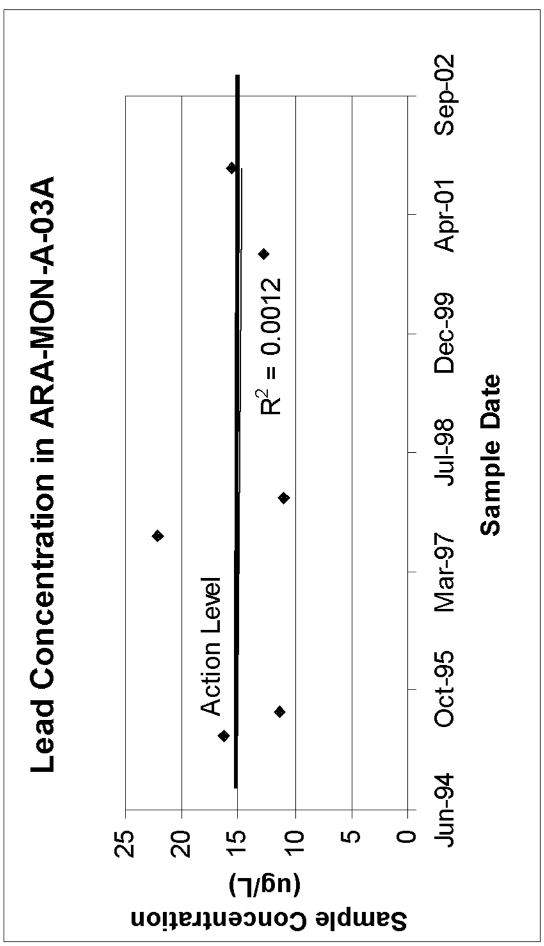
Appendix B
Lead Concentration Graphic Analyses

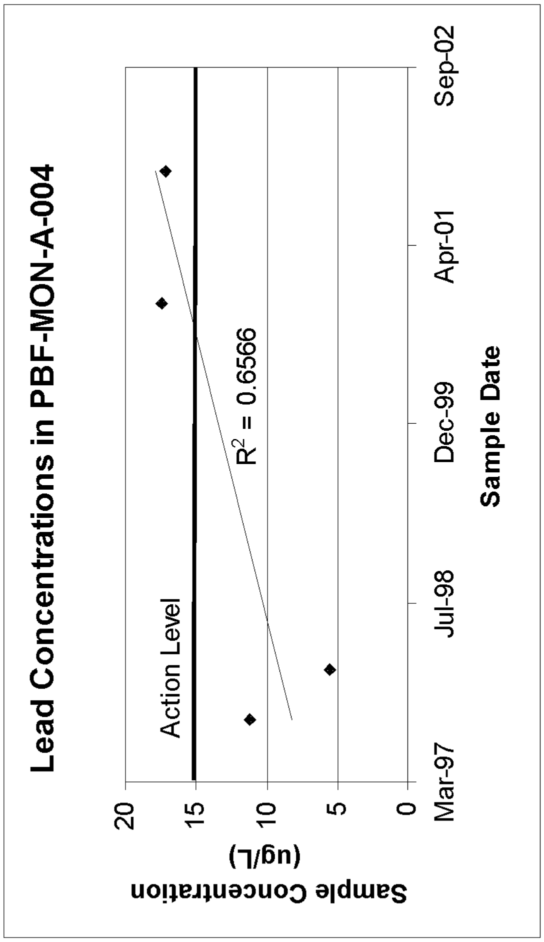









Lead Concentration in ARA-MON-A-03A
Action Level
R^2 = 0.0012
Sample Concentration (ug/L)
25
20
15
10
5
0
Jun-94
Oct-95
Mar-97
Jul-98
Dec-99
Apr-01
Sep-02
Sample Date


Lead Concentrations in PBF-MON-A-004
Action Level
R^2 = 0.6566
Sample Concentration (ug/L)
20
15
10
5
0
Mar-97
Jul-98
Dec-99
Apr-01
Sep-02
Sample Date

Appendix C

Quality Assurance/Quality Control Sample Results

Appendix C

Quality Assurance/Quality Control Sample Results

C-1. QUALITY ASSURANCE/QUALITY CONTROL SAMPLING

The purpose of collecting and analyzing quality assurance/quality control samples is to confirm the achievement of project objectives and data quality objectives. The overall objectives associated with the WAG 5 annual groundwater monitoring are discussed in the Groundwater Monitoring Plan (DOE-ID 2000a). The overall objectives and quality assurance or quality control sample results for the FY 2002 sampling effort are discussed in the following sections.

C-1.1 Precision and Accuracy

The spatial variations in the concentrations of contaminants at individual sites create sampling variability. Additional variability, called measurement error, occurs during sample collection, handling, processing, analysis, quality evaluation, and reporting. Concentrations of contaminants reported represent the true concentrations in the media sampled plus the measurement error, which can be minimized but not eliminated. Though it may not be significant in many cases, it is important to assess the contribution of measurement error to the total error in individual investigations. The analytical results of quality control samples are used to estimate accuracy and precision, the quantitative descriptions of measurement error, and bias.

C-1.1.1 Overall Precision

Precision is a measure of the reproducibility of measurements under a given set of conditions. In the field, precision is affected by sample collection procedures and by the natural heterogeneity of the matrix. Overall precision (field and laboratory) can be evaluated by the use of duplicate samples collected in the field. Greater precision typically is required for analytes with very low action levels that are close to background concentrations. Allowable laboratory precision for water samples is defined as having a relative percent difference (RPD) of less than or equal to 20%. Field precision is the difference between overall precision and laboratory precision. Table 3-1 summarizes the precision for the FY 2002 round of groundwater monitoring. The RPD was calculated only for those samples that were true positive values for both the initial sample and the field duplicate. Using the formula

$$\mathrm{RPD} = \frac{|\mathrm{S} - \mathrm{D}|}{\mathrm{S} + \mathrm{D}} \times 200$$

where

S = sample

D = dupicate.

As can be seen from the data in Table 3-1, only lead has a RPD that exceeds 20%. However, concentrations less than 10 times the instrument detection limit are statistically more likely to have errors than larger concentrations. Because the lead concentration is very close to the instrument detection limit, it is not unreasonable for the RPD to exceed 20%. With only the RPD for lead exceeding 20%, the overall precision of the FY 2002 data is considered acceptable.

Table C-1. Overall precision for FY 2002 analytical data.

Analyte	Sample	Duplicate	Units	RPD (%)
Barium	43.7	39.4	mg/L	10.3
Chromium	2.7	2.5	mg/L	7.7
Lead	12.7	8.1	mg/L	44.2
Chloride	17.4	18.7	mg/L	7.2
Fluoride	0.399	0.416	mg/L	4.2
Nitrate	1.02	1.08	mg/L	5.7
Sulfate	18.6	19.8	mg/L	6.3

C-1.1.2 Overall Accuracy

Accuracy is a measure of bias in a measurement system. Accuracy is affected by the methods used for sample preservation, sample handling, field contamination, and sample matrix. The effects of the first three are evaluated using the field blank, trip blank, and equipment rinsate results. The presence of a contaminant in the field blank, trip blank, or rinsate reveals that cross-contamination has occurred.

Laboratory accuracy is ensured through the use of standard methods and the use of calibration standards from to the National Institute of Standards and Technology. All instrumentation is calibrated prior to use as per the procedures outlined in the analytical methods required by the INEEL SMO statements of work. Laboratory accuracy is assessed through the use of matrix spikes and laboratory control samples. The number of laboratory quality control samples is specified in the analytical methods employed and in the INEEL SMO statements of work. Evaluation criteria for the quality control samples are specified in data validation technical procedures administered by the INEEL SMO. For samples analyzed in accordance with EPA Contract Laboratory Program protocol, validation is performed in accordance with that protocol. For the FY 2002 data set, the overall accuracy of the analyses is acceptable.

C-1.1.3 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which the sampling and analysis data accurately and precisely represent the characteristic of a population parameter being measured at a given sampling point or for a process or environmental condition. Representativeness is evaluated by determining whether measurements were made and physical samples collected in such a manner that the resulting data appropriately measure the media and phenomenon measured or studied.

For the FY 2002 sampling activity, all measurements were made according to established EPA and INEEL SMO protocol. The physical samples were collected by trained personnel using established INEEL procedures. The one difficulty encountered was the analysis of I-129. The detection limit employed by the laboratory was approximately 1 pCi/L as compared to the MCL of 1 pCi/L as established by the EPA. An effort has been undertaken at the INEEL to locate a laboratory capable of achieving lower detection limits approaching 0.1 to 0.2 pCi/L. This will ensure that the laboratory measurements are more representative of the groundwater quality at WAG 5.

C-1.1.4 Completeness

Completeness is a measure of the quantity of usable data collected during the field sampling activities. The Groundwater Monitoring Plan (DOE-ID 2000a) requires an overall completeness goal of 90% for this project. For FY 2002, a total of nine wells was to be sampled with a total of 63 possible analyses (seven per well). All 63 analyses were performed resulting in a completeness of 100%.

C-1.1.5 Comparability

Comparability is a qualitative characteristic that refers to the confidence with which one data set can be compared to another. At a minimum, comparable data must be obtained using unbiased sampling designs. If sampling designs are not unbiased, the reasons for selecting another design should be well documented. Data comparability for this sampling activity was ensured through the following efforts:

- All data sets contained the same variables of interest
- All measurements have been performed and results reported using common units
- Similar analytical procedures and quality assurance measures have been used
- All field and laboratory instrumentation had similar or better detection limits than historically employed
- All samples were collected following established INEEL procedures
- Wells selected for sampling are identical to those historically chosen.

Samples were collected in the November timeframe, which was different from historical sampling rounds that occurred in April, July/August, August, and January. However, historical data collected at other sites at the INEEL indicate that contaminant concentrations are unaffected by seasonal factors. In an effort to negate any effect that changes in groundwater levels due to snow melt and runoff may have on data collected, this and future sampling rounds will be conducted at approximately the same time of year.

C-1.2 Data Validation

Method data validation is the process whereby analytical data are reviewed against set criteria to ensure that the results conform to the requirements of the analytical method and any other specified requirements. For the FY 2002 sampling activity, all laboratory data were validated according to established INEEL SMO and EPA protocols. The limitations and validation reports were previously transmitted to the Agencies in February 2002. No major problems were identified during this method validation process.